

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2003-77548

(P2003-77548A)

(43) 公開日 平成15年3月14日 (2003.3.14)

(51) Int.Cl. ⁷	識別記号	F I	テームコード* (参考)
H 0 1 M 10/48		H 0 1 M 10/48	P 2 G 0 1 6
G 0 1 R 31/36		G 0 1 R 31/36	A 5 G 0 0 3
H 0 1 M 10/44		H 0 1 M 10/44	A 5 H 0 3 0
H 0 2 J 7/00		H 0 2 J 7/00	X

審査請求 未請求 請求項の数 9 O L (全 14 頁)

(21) 出願番号 特願2002-162356 (P2002-162356)

(22) 出願日 平成14年6月4日 (2002.6.4)

(31) 優先権主張番号 特願2001-173443 (P2001-173443)

(32) 優先日 平成13年6月8日 (2001.6.8)

(33) 優先権主張国 日本 (J P)

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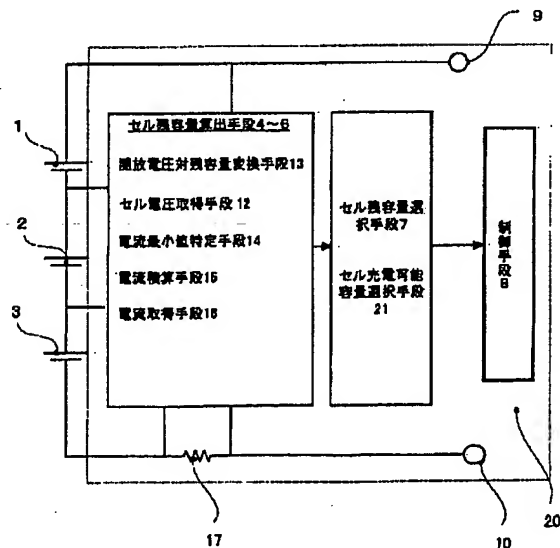
Fターム(参考) 2G016 CA03 CA04 CB11 CB12 CB21
CB22 CB31 CB32 CC01 CC03
CC06 CC07 CC12 CC23 CC27
CD02 CD14 CE03
5G003 BA03 CA05 CA16 EA05 GC05
5H030 AA03 AA04 AS06 BB01 FF41
FF42

(54) 【発明の名称】 組電池の電池管理方法とシステム

(57) 【要約】

【課題】 複数の電池セルが直列接続された組電池のセルバランスが崩れた時、従来のように電池電圧だけで電池セルの残容量を調整しても、実際には組電池の残容量を算出できない。従って組電池の残容量データを基に行う組電池機器システムの電源管理は極めて困難である。そこで組電池の残容量を正確に求めて、残容量の表示や組電池の安全な充電や機器の消費電力をコントロールできるようにする事が課題である。

【解決手段】 各電池セルの電圧ではなく、セル残容量を調整する事で組電池の残容量表示あるいは組電池機器システムのコントロールを行う。そのために組電池管理手段の中に、各セル独立した正確なセル残容量算出手段を所有する事で課題を解決する。



AL2

【特許請求の範囲】

【請求項1】直列接続した複数の電池セルからなる組電池と電池管理手段で構成する組電池機器システムに於いて、該電池管理手段が、セル残容量算出手段あるいはセル充電可能容量算出手段と、セル残容量選択手段あるいはセル充電可能容量選択手段と、該組電池機器システムのコントロールをする制御手段を有し、該セル残容量算出手段は複数の該電池セルの残容量を算出し、求めた該複数のセル残容量の内から該組電池の残容量に使用する該セル残容量を選択し、該充電可能容量選択手段は該セル充電可能容量算出手段を用いて算出したセル充電可能容量の内から該組電池の充電可能容量を選択し、該制御手段は選択した該セル残容量あるいは該セル充電可能容量を使用して該組電池機器システムのコントロールを行う組電池管理方法。

【請求項2】該セル残容量算出手段は、該電池セルに出入りする電流をカウントして電気量Qを求める電流積算手段と、電流最小値特定手段と、セル電圧を取得するセル電圧取得手段と、該電池セルの開放電圧を該電池セルの残容量に変換する開放電圧対残容量変換手段を有し、該電流最小値特定手段が、電流最小値以下に特定した時、該セル電圧取得手段で該電池セルの電圧を取得し、該電圧を該開放電圧対残容量変換手段で該電池セルの残容量に変換し、次に電流が該電流最小値を超えた時、該開放電圧対残容量変換手段によって得られた該残容量を初期値にすると共に、該電流積算手段を使用して積算した電気量Qを、該初期値に加算あるいは減算して該電池セルの該残容量を更新する請求項1の組電池管理方法。

【請求項3】該制御手段は、該組電池の残容量を表示する手段である請求項1の組電池管理方法。

【請求項4】該制御手段は、該組電池の充電をコントロールする手段である請求項1の組電池管理方法。

【請求項5】該制御手段は、該電池セルの残容量を独立して変化させる手段である請求項1の組電池管理方法。

【請求項6】該セル残容量算出手段あるいは該セル充電可能容量算出手段が、セルバランス調整用の閉回路に流れる電流を積算し、該組電池全体に流れる電流を積算して得られる電気量に加算あるいは減算して該セルに流れた電気量とする請求項1の組電池管理方法。

【請求項7】該制御手段は、該組電池機器システムの消費電力を変化させる手段である請求項1の組電池管理方法。

【請求項8】請求項1の組電池管理方法を使用する組電池管理システム。

【請求項9】請求項1の組電池管理方法をプログラムした記録媒体。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】組電池で駆動する電池機器システムに於いて、残容量表示や充電や機器のパワーセー

ブや電池セルのバランス調整等を行う電池管理方法とシステム、およびその方法を保存した記録媒体に関する。

【0002】

【従来の技術】組電池機器システムとは、組電池と電池管理手段をケースに収めた電池パックの形態が基本であるが、ノートパソコンやビデオカメラやハイブリッドカーのように組電池とセット本体が通信を行い電池の管理を行う形態も含まれる。従来電池で駆動する機器の中でも、携帯電話やデジタルスチルカメラ等は電池1個の単セル電圧で駆動できるが、ビデオカメラやノートパソコン等は、電池電圧の高いリチウムイオン電池を使用しても単セル電圧では不足である。そこで単セルを複数個直列に接続して組電池にして所望の電池電圧を得ている。また従来の電池管理手段では、電池残容量を算出して液晶等の表示装置に表示して、使用者が機器の電源を切ったり、充電したりする管理に使用されている。あるいは電池残容量が少なくなってくると、自動的に液晶の明るさを落として、パワーセーブする電池管理を行っている機器も存在する。いずれも電池残容量を求めて、その情報に基づいて電池管理を行う方法である。

【0003】その電池残容量の算出は、従来から単セル電池の場合、電池セルの電圧から電池残容量に変換する電圧方法や電池に出入りする電流を積算する電流積算方法がある。あるいは電圧方法と電流方法を組み合わせた方法がある。組電池の場合は組電池全体を一つのセルと見なして、組電池全体の電圧や組電池全体に出入りする電流を検出して、単セル電池と同様な方法が実施されている。

【0004】また、直列接続した組電池では各電池セルの電圧バランスが崩れる問題がある。電圧のバランスの崩れる原因としては、電池セルを組電池に組上げた時、最初から電池セルの電圧が異なっている場合や、各電池セルの電池容量が異なっている場合が上げられる。電池セルの電圧バランスが崩れると、充電時、電圧の高い電池セルが過充電になったり、他の電池セルが充電不足になる問題がある。また放電時は電池電圧の低い電池セルが過放電になったり、他の電池セルの電池容量が残ったまま組電池全体では放電終止電圧になる問題がある。いずれにしても、結果的に組電池の使用可能容量が低下する。そこで従来は各電池セルの電圧を独立して検出して、各電圧に所定電圧以上の差が生じた時、電圧の高い電池セルを放電して電圧の低い電池セルの電圧に合わせるコントロールを行っている。

【0005】

【発明が解決しようとする課題】通常電池セルを直列接続して組電池にする場合、基本的にほぼ同じ容量の電池セルを使用すると共に、全ての電池セルの電圧がほぼ同じになるように、いわゆるセルバランスをとって組上げている。従って組電池の電池残容量を算出する上で、新品電池の間は、従来の電池残容量算出方法であっても問

題のない場合が多い。しかし何度も繰り返し充放電を繰り返していると、劣化等で各電池セルの容量が不均一になり、各電池セルの電圧も不均一になる。すると充電時、組電池全体では正常な充電電圧であっても、電池容量の大きな電池セルでは充電電圧が不足して満充電まで達しないで、組電池としては充電不足のまま満充電になってしまう問題がある。また放電時、組電池全体の放電終止電圧に到達した時、まだ電池容量が残っている電池セルが有り、組電池としては容量を使い切らない内に終止電圧になってしまう問題がある。従って当然組電池の実残容量は算出値より少なく、従来の算出方法を用いている組電池機器システムの残容量表示の精度は大幅に低下する。

【0006】その上、充電時、電池容量の小さな電池セルは過充電になるので、安全性が低下したり、リチウムイオンセルを使った組電池では過電圧保護回路が作動し、組電池の電流を遮断して、機器が使用できなくなる大きな問題が発生する。そのために従来、各電池セルの電圧バランスが崩れてくると、スイッチと放電抵抗で構成する閉回路を各電池セルに設けて、高い電圧の電池セルを、低い電圧の電池セルの電圧になるまで放電する等のセルバランス調整をする管理方法が数種類ほど提案されている。例えば、実願平5-47535、特願8-200260、特願平9-346550、特願10-32887、特願平11-61307等が特許あるいは実用新案として出願されている。しかし、いずれの方法も、各電池セルの電圧を一致させる調整方法である。ところが、電池容量バランスの崩れた各電池セルの電圧を同一にしても、各電池セルの残容量や満充電するまでの充電可能容量は同一にならないので、組電池の残容量表示精度には大きな誤差が発生する。さらには組電池を充放電すると、直列接続した各電池セル電池に流れる電流は同じであるから、充電した時は過充電になる電池セルが発生し、放電した時は過放電になる電池セルが発生する大きな問題も解消できていない。

【0007】従って本発明の目的とするところは、複数の電池セルが直列接続された組電池において、セルバランスが崩れた時も、組電池全体の正確な残容量を算出して残容量表示やコントロールを行い、機器使用者あるいは機器が自動的に組電池の制御を正確に行える管理方法、あるいはシステム、あるいは方法を記録した記録媒体を提供する事を目的としている。

【0008】

【課題を解決するための手段】直列接続した複数の電池セルからなる組電池と組電池管理手段で構成する組電池機器システムにおいて、上記目的を達成するために、本発明は、組電池管理手段が次の技術的手段を有する。それは、複数の電池セルのセル残容量算出手段と、求めた複数のセル残容量の中から組電池の残容量として使用するセル残容量を選択するセル残容量選択手段、あるいは

複数の電池セルのセル充電可能容量算出手段と、複数の充電可能容量の中から組電池の充電可能容量として使用するセル充電可能容量を選択するセル充電可能容量選択手段と、組電池機器システムの制御手段である。すなわち本発明は、従来のように組電池全体の電圧と、出入りする電流の管理、あるいは各電池セルの電圧だけを管理するのではなく、各電池セルの残容量を管理する事で、組電池の残容量表示あるいは組電池機器システムのコントロールを行う方法である。あるいはその方法を構成するシステム、あるいはその方法を記録した記録媒体である特徴がある。

【0009】さらに本発明は、電池セルの残容量を算出する手段として、本発明者が、特願2001-173443にて特許出願した電池の残容量変換方法を採用した。従来は、組電池におけるセルバランスの崩れた各電池セルの残容量算出が極めて困難であったが、特願2001-173443による電池の残容量変換方法を使えば容易に電池セルの残容量を算出できる特徴がある。

【0010】また本発明の制御手段は、セル残容量算出手段が算出したセル残容量の中からセル残容量選択手段が選択したセル算容量を用いて、該組電池の残容量を表示する事で、機器の使用者が主導で機器のパワーセーブを行える特徴がある。

【0011】また本発明の制御手段は、セル充電可能容量算出手段が算出したセル充電可能容量の中から、セル充電可能容量選択手段が選択したセル充電可能容量を用いて、組電池の充電をコントロールする特徴がある。

【0012】また本発明は、制御手段が任意の電池セルの残容量を独立して変化させてセルバランスを整える事で、組電池の使用可能容量の低下を押さえると共に、安全性を高める特徴がある。

【0013】また本発明は、各電池セルに独立して設けるセルバランス調整用の閉回路に流れた電気量を、組電池全体に流れた電気量に加算あるいは減算して各電池セルに流れた電気量にして、セル残容量算出手段あるいはセル充電可能容量算出手段の精度を高める特徴がある。

【0014】また本発明の制御手段は、組電池機器システムを自動的にコントロールして機器のパワーセーブをする特徴がある。

【0015】また本発明は、制御手段が自動的に機器のパワーセーブを行う特徴がある。

【0016】

【発明の実施の形態】本発明の実施の形態1を、図1のブロック図を用いて詳細に説明する。先ずn個の電池セルを直列接続して組電池にする。図1では、nは3個として説明するが、nは2個以上であれば説明の趣旨は変わらない。各電池セル1～3にはそれぞれセル残容量算出手段4～6を並列に接続する。また各セル残容量算出手段4～6はそれぞれセル残容量選択手段7に入力する。さらにセル残容量選択手段は制御手段8に入力す

る。そして組電池への入出力は陽極9と陰極10を通して行う。セル残容量算出手段4〜6とセル残容量選択手段7と制御手段8の動作プログラムはマイコン11に収める。

【0017】セル残容量算出手段4〜6は、本発明者が特願2001-173443にて特許出願した、電池の残容量変換方法を用いて図2で説明する。セル残容量算出手段4〜6は各電池セル1〜3の残容量をそれぞれ独立して算出する手段であるが、その構成は同じで良く、また一つのセル残容量算出手段4をマルチプレクサ等で、電池セル1〜3を切り替えて使用しても良い。すなわち残容量算出手段4〜6をセル電圧取得手段12と開放電圧対残容量変換手段13と電流最小値特定手段14と電流積算手段15と電流取得手段16で構成する。電流取得手段16は電池セル1〜3に直列に接続した電流検出抵抗17の両端に発生する電圧を検出する、電流検出の一つの方法を用いた。

【0018】そしてその動作フローを図3に示す。先ずステップ1、以降(S1)と表示するが、電源オン(S1)するとマイコン11がオン(S2)する。次に電流取得手段16で流れる電流を検出する(S3)。次に電流最小値特定手段14を使って電流最小値を特定する(S4)。

【0019】次に電池電圧取得手段12を使って電池セル1〜3の開放電圧を取得する(S5)。一般に開放電圧とは、電池の陽極と負極を結ぶ電気回路をオープンにした時、すなわち電池に出入りする電流がゼロの場合の電圧である。但し電流が微小であればある程、電圧は開放電圧に近づくので、電流が最小値以下になった時の電圧を開放電圧と規定しても良い。例えば携帯電話であれば、待受け時の微小な電流のみが流れる状態、あるいはノートパソコンであれば、電源はオフしてもセル電圧を取得してメモリーするだけの微小な電流のみが流れる状態がある。その時のセル電圧を開放電圧と見なす事ができる。

【0020】次に開放電圧対残容量変換手段13を使って、取得した電池セル1〜3の開放電圧(S5)を残容量に変換する(S6)。開放電圧対残容量変換手段13は、あらかじめ電池セル1〜3が劣化していない初期の時の電池特性を測定して、開放電圧対残容量のデータを取得し、変換テーブル18にして、ROM等の不揮発性メモリーに保存する。

【0021】次に電流が最小値を超えて流れ始めると(S7)、変換して得た電池セル1〜3の残容量(S6)を初期値(S8)にし、電流積算手段5を使って、流れる電流を積算して、流れた電気量Qをカウントする(S9)。ところで本明細書の中では、放電電流をプラス、充電電流をマイナスで計算する。

【0022】次に電池セル1〜3の残容量の初期値(S8)からカウントした電気量Q(S9)を減算あるいは

加算する(S10)。こうして電池セル1〜3の残容量は初期値(S8)を電気量Q(S9)で減算あるいは加算しながら新しい残容量に更新する(S11)。

【0023】ここまでの動作フロー(S1)〜(S11)は各電池セル1〜3について、それぞれ独立に実施する。従って3個の残容量が得られる。電池セル1〜3の残容量をそれぞれCr(1)〜Cr(3)と表示する。

【0024】次にセル残容量選択手段7で、Cr(1)〜Cr(3)の中からもっとも残容量の少ない電池セル残容量を選んで(S12)、組電池の残容量を確定する(S13)。

【0025】次に確定した組電池残容量(S13)を制御手段8に入力する。制御手段8は液晶ディスプレイ等に残容量表示を行う。機器使用者は組電池の残容量を確認して、機器の電源を切ったり、電池を交換する等の電池管理を行う事ができる。

【0026】次に組電池の充電をコントロールする実施の形態2を説明する。電池セル1〜3と組電池管理手段20の構成は実施の形態1で示した図2と同じである。また図3に示す動作フローのステップ(S1)〜(S11)は同じなので、(S11)以降を図4に示す。さて各電池セル1〜3の満充電における残容量すなわち容量は、組電池に組み上げた時から同じであるとは限らない。また劣化などの要因で各容量のバラツキは拡大する。そこで各電池セルの容量を区別してCf(1)〜Cf(3)と表示し、充電可能容量をCp(1)〜Cp(3)と表示すると(1)式の関係が成立する。

【0027】

【数1】

$$C_p(m) = C_f(m) - C_r(m), m = 1 \sim 3 \quad \dots (1)$$

【0028】そしてセル充電可能容量選択手段21は(1)式でCp(m)を求めて、その中でもっとも少ないCp(min)を選択する(S16)。次にそのCp(min)を組電池の充電可能容量であると確定する(S17)。次に制御手段8を用いて、組電池をCp(min)だけ充電する(18)。するといずれの電池セル1〜3も過充電する事なく、組電池を最大容量まで充電する事ができる。

【0029】前記したごとく、各電池セル1〜3の各容量Cf(m)は同じだとは限らない。さらには劣化によって各電池セルの容量が変化すると、従来の電池残容量算出方法では、組電池に組まれた電池セル1〜3の劣化度を算出する事ができないのでCf(m)を求める事ができない。従来の電圧方法や電流積算方法はCf(m)が基準値あるいは初期値になるので、Cf(m)が求まらない現状では、各電池セル1〜3の実残容量や実充電可能容量を求めるのは不可能と言える。

【0030】そこで、各電池セルのCf(m)を求め、また補正する方法である実施の形態3を図5の動作フロー図を使って説明する。図5は特願2001-173443に示した容量劣化度の算出方法である。先ず電流最小値以下を検出する(S13)と、電池セル1〜3の各開放電

圧 V_n を取得し(S5)、セル残容量 $Crn0$ に変換する(S6)。ここで V_n のごとく下付きの符号 n は電流最小値以下を検出した回数を示し、 $Crn0$ は劣化していない時の電池セルの n 回目のセル残容量を示す。

【0031】次にステップ13に戻るが、組電池に流れる電流が電流最小値を超える電流であると、 $Crn0$ を初期値にして(S8)、組電池に流れる電気量 Q_n をカウントする(S9)。再び電流最小値を検出する(S13)まで、電気量 Q_n はカウントアップされ続ける(S9)。再び電流最小値以下を検出する(S13)と、開放電圧 $V_{(n+1)}$ を取得し(S5)、セル残容量 $Cr_{(n+1)0}$ に変換する(S6)。ところで、セル残容量 $Crn0$ と残容量 $Cr_{(n+1)0}$ は、開放電圧対残容量変換手段13、すなわち図3のテーブル18を参照して、開放電圧 V_n と $V_{(n+1)}$ から変換した残容量である(S6)。テーブル18から求めるセル残容量は、電池セルが劣化していない基準電池セルの残容量である。一方電気量 Q_n は、電圧 V_n を取得して(S5)から、再び電圧 $V_{(n+1)}$ を取得する(S5)までの間に実際に使用した容量である。従って電池セルが劣化した比率を示すセル劣化度 α_c の基本式は(2)式で表される。

【0032】

【数2】

$$Crn(m) = Crn0(m) / \alpha_c(m), \quad m = 1 \sim 3 \quad \dots \quad (3)$$

【0036】また実容量 Cf はセルの劣化を考慮した満充電時のセル実残容量とし、基準電池の満充電時のセル残容量を容量 $Cf0$ とすると、 Cf は(4)式で表される。

【0037】

【数4】

$$Cf(m) = Cf0(m) / \alpha_c(m), \quad m = 1 \sim 3 \quad \dots \quad (4)$$

【0038】通常電池セル1～3を接続して組電池にする時、一つ々々の電池セル1～3の容量 $Cf0$ は実測していない。しかしできるだけ均一にするために同一生産ロットの中の電池セルを組み合わせる。従って放電カーブや充電カーブなどの電池特性はほぼ相似になっている。従ってその生産ロットの平均的な特性を実測して、あらかじめ標準容量 $Cf0(avr)$ を決定しておけば、 $Cf(m)$ は(4)式の $Cf0(m)$ を $Cf0(avr)$ で置換えて式(2)と式(4)で補正して求める事ができる。

【0039】このように各電池セル1～3の満充電時の実容量が、劣化等の要因で変化しても求まるので、セル残容量とセル充電可能容量が算出できる。従って制御手段8で、組電池の正確な残容量と充電可能容量が液晶ディスプレイ等に表示できる。また電池セル1～3の過充電を防いで安全性を高める事ができる。

【0040】次に制御手段8が電池セル1～3のセルバランスを取る実施の形態4を図6のブロック図を用いて説明する。各電池セル1～3に並列にスイッチ19～21とバランス抵抗22～24を直列に接続して閉回路25～27を図2に追加した構成である。

【0041】次に、制御回路8が電池セル1～3の実残

$$\alpha_c = (Crn0 - Cr_{(n+1)0}) / Q_n \quad \dots \quad (2)$$

【0033】式(1)の劣化度 α_c では、劣化していないセルであれば α_c は1で、劣化する程大きくなる扱いにしている。また放電時の電気量 Q_n はプラスで充電時の電気量 Q_n はマイナスで扱っている。但し Q_n が非常に小さいと、 V_n と $V_{(n+1)}$ の差も小さくなって、セル電圧取得手段12で電圧差を判別できなくなる恐れがある。そこで Q_n は所定量以上の場合だけ採用する必要がある。電池セルの劣化は徐々に進む傾向があり、頻繁にセル劣化度 α_c を更新する必要がないので、 Q_n が十分に大きくてセル劣化度 α_c が正確に求まる時だけ、本実施例を実施すれば良い。

【0034】図5のフローには示していないが、こうして求まったセル劣化度 α_c が1でない場合は、ステップ6のセル残容量 $Crn0$ を α_c で割って補正して実残容量 Crn を求める。またステップ8の初期値も、セル残容量 $Crn0$ をセル実残容量に更新する。補正は(3)式で表される。 m はそれぞれの電池セル1～3について独立に算出する事を示す。

【0035】

【数3】

容量を使ってバランスを取る場合の動作フローになるように、図3を変更した図7について説明する。図7は図3のステップ9から以降を示す。まず電池セル1～3の残容量算出の結果(S11)からセル残容量が最少の残容量 $Cr_{(min)}$ を選択した(S12)。例えばそれが電池セル1であるとする、他の電池セル2、3の残容量 $Cr(2)$ 、 $Cr(3)$ は $Cr(1)$ よりも多い。そこで制御手段8を使ってスイッチ20、とスイッチ21をオンする。すると閉回路26ではバランス抵抗23を介して電池セル2に単独の電流が流れて、 $Cr(2)$ を消費する。電池セル3に於いても、閉回路27では $Cr(3)$ が消費されるのは同様である。 $Cr(2)$ と $Cr(3)$ はそれぞれ $Cr(1)$ と等しくなるまで放電し、ほぼ等しくなったところで(S22)、スイッチ20とスイッチ21をオフして閉回路26、27での放電をストップする(S23)。

【0042】ところでスイッチ20、21がオンしている間、ステップ20では閉回路26、27に流れる電流をカウントして電流積算も行い、その電気量をステップ11で更新したセル残容量から減算する(S21)。それをステップ11に戻して、閉回路に流れる電気量も含めたセル残容量に更新する。このようにセル残容量 $Cr(2)$ 、 $Cr(3)$ 、 $Cr(1)$ が等しくなるようにコントロールすると、組電池が放電終止電圧に達した時、電池セル1～3の残容量は等しくゼロになると共に、各電池セル1～3の電圧も等しく終止電圧になって正常なセルバランスが確保できる。

【0043】次に、制御回路8が、電池セル1～3の実充電可能容量を使ってセルバランスを取る場合の動作フ

ローになるように図7を変更した図8について説明する。先ず電池セル1～3のセル充電可能容量算出の結果(S15)から最大のセル充電可能容量 $C_p(\max)$ を選択した(S16)。例えばそれが電池セル1であるとする、他の電池セル2、3の充電可能容量 $C_p(2)$ 、 $C_p(3)$ は $C_p(1)$ よりも少ない。そこで制御手段8を使ってスイッチ20、とスイッチ21をオンする(S19)。すると閉回路26ではバランス抵抗23を介して電池セル2に単独の電流が流れて、 $C_r(2)$ を消費する。電池セル3に於いても、閉回路27では $C_r(3)$ が消費されるのは同様である。 $C_r(2)$ と $C_r(3)$ は $C_p(2)$ と $C_p(3)$ が $C_p(1)$ と等しくなるまで放電し、ほぼ等しくなった(S22)ところでスイッチ20とスイッチ21をオフ(S23)して閉回路26、27での放電をストップする。

【0044】またステップ20では電流をカウントして電流積算も行い、その電気量をステップ11で更新したセル残容量から減算する(S21)。それをステップ11に戻して、閉回路に流れた電気量も含めてセル残容量を更新するのは放電の場合と同様である。このようにセル充電可能容量 $C_p(2)$ 、 $C_p(3)$ 、 $C_p(1)$ が等しくなるようにコントロールすると、組電池が満充電に達した時、電池セル1～3も等しく満充電になるので、過充電になる電池セルは発生しない。従って充電における正常なセルバランスが確保できる。

【0045】次に制御手段8が組電池機器システムの消費電力を自動的にコントロールする実施の形態5を説明する。例えばビデオカメラであれば、組電池の残容量が残り少なくなってくると、液晶のバックライトを消灯する等のパワーセーブを行う。また電池モーターとガソリンエンジンで駆動するハイブリッドカーであれば、組電池の残容量が少なくなってくると、電池モーター駆動からガソリンエンジン駆動に切り替えるコントロールを行う。これらの機器コントロールの自動化は周知の技術なので、図面を使った詳細な説明は省略する。

【0046】

【発明の効果】請求項1においては、従来のように組電池全体の電圧と出入りする電流の管理、あるいは各電池セルの電圧だけを管理するのではなく、残容量算出手段を4～6を用いて求めた各電池セル1～3の残容量を管理する。従ってセルバランスの崩れた組電池であっても、正確な組電池の実残容量で組電池の残容量表示あるいは組電池機器システムのコントロールを行う。その結果セルバランスが崩れるにつれて、組電池全体の管理精度が低下して行く問題点を解決する効果がある。

【0047】請求項2においては、本発明者が特願2001-173443にて特許出願した電池の残容量変換方法を採用する事で、従来不可能とされていたセルバランスの崩れた組電池における電池セル1～3の残容量を正確に求める事が可能になり、電池機器システムの電源管理を正確にできるようになる効果は大きい。

【0048】請求項3においては、制御手段8が請求項1に基づいたセル残容量を算出し、残容量表示を行う事で、機器使用者が電源管理を正確に実施できる効果がある。

【0049】請求項4においては、制御手段8が請求項1に基づいて算出したセル残容量を使用してセル充電可能容量を算出し、その計算結果に基づいて制御手段8が充電をコントロールする。従って過充電になる電池セルが発生する事なく充電できるので安全性に対する効果が大きい。

【0050】請求項5においては、請求項1に基づいてセル残容量算出手段が算出したセル残容量を使用し、正確なセルバランスの崩れの量を算出する。そして制御手段8が、その崩れ量分だけセルの残容量あるいは充電可能容量を調整するので、精度のよいセルバランスが確保できる効果は大きい。

【0051】また請求項6においては、各電池セル1～3に独立して設けるセルバランス調整用の閉回路25～27に流れた電気量を、組電池全体に流れた電気量に加算あるいは減算して各電池セル1～3に流れた電気量にするので、セル残容量算出手段あるいはセル充電可能容量算出手段の精度を高める効果がある。

【0052】また請求項7においては、制御手段8が、組電池機器システムの消費電力を自動的に変化させるので、機器の使用時間を延ばせる効果がある。

【0053】また請求項8においては、請求項1に基づく正確な組電池管理方法を電池機器システムに構成するので、機器の電源管理の精度が格段に良くなる効果がある。

【0054】また請求項9においては、請求項1に基づく正確な組電池管理方法のプログラムをマイコン内のROM等の記録媒体に保存する事で、量産してコストダウンでき、組電池機器システムを小型化できる効果がある。

【図面の簡単な説明】

【図1】実施の形態1の組電池管理方法のブロック図である。

【図2】実施の形態1の組電池管理方法のブロック図である。

【図3】実施の形態1の組電池管理方法のフローチャートである。

【図4】実施の形態2の組電池管理方法のフローチャートである。

【図5】実施の形態3の組電池管理方法のフローチャートである。

【図6】実施の形態4の組電池管理方法のブロック図である。

【図7】実施の形態4の組電池管理方法のフローチャートである。

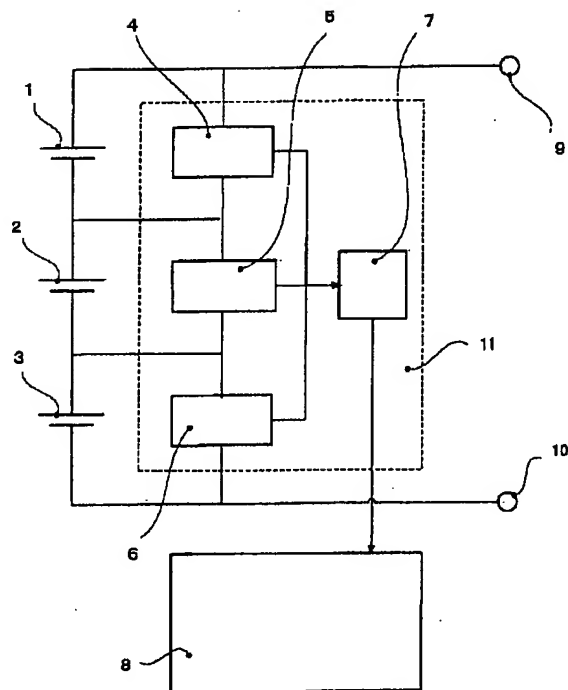
【図8】実施の形態4の組電池管理方法のフローチャートである。

【符号の説明】

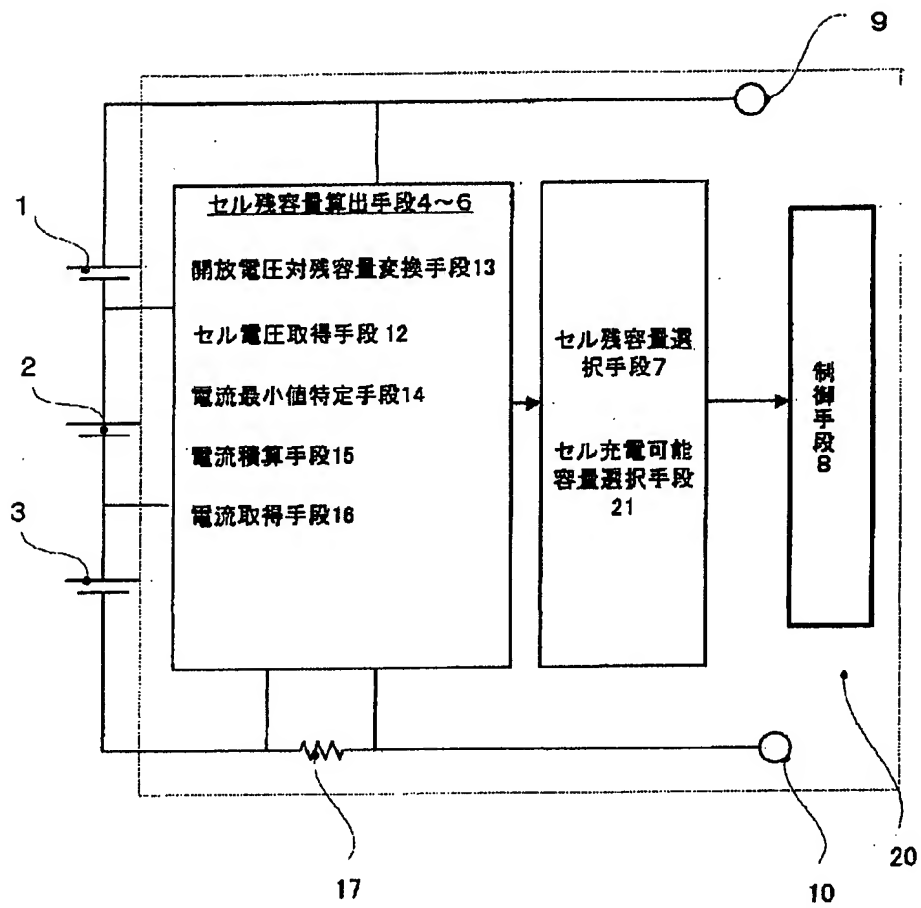
1, 2, 3は電池セル
 4, 5, 6はセル残容量算出手段
 7はセル残容量選択手段
 8は制御手段
 9は陽極
 10は陰極
 11はマイコン
 12はセル電圧取得手段

13は開放電圧対残容量変換手段
 14は電流最小値取得手段
 15は電流積算手段
 16は電流取得手段
 17は電流検出抵抗
 18は変換テーブル
 19, 20, 21はスイッチ
 22, 23, 24はバランス抵抗
 25, 26, 27は閉回路

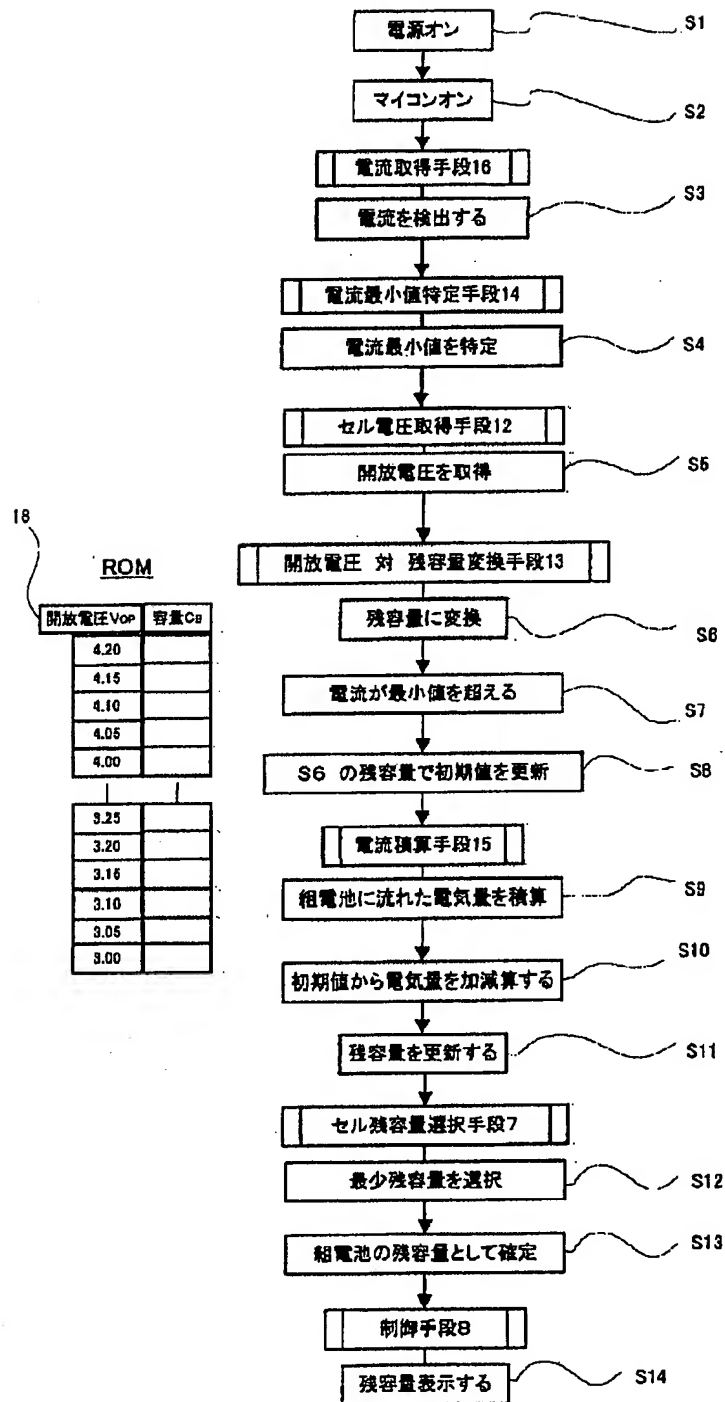
【図1】



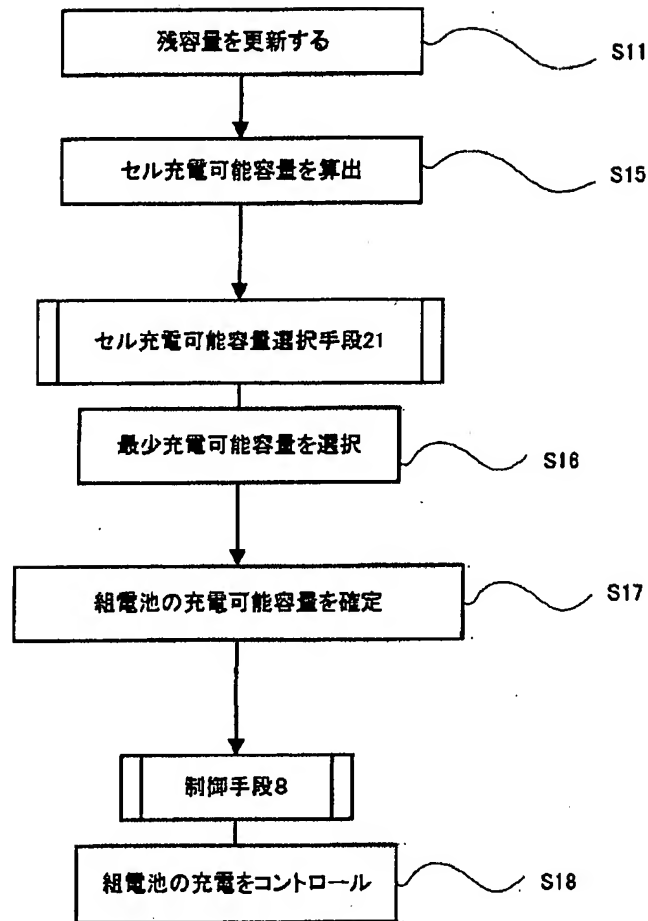
【図2】



【図3】



【図4】



【図5】

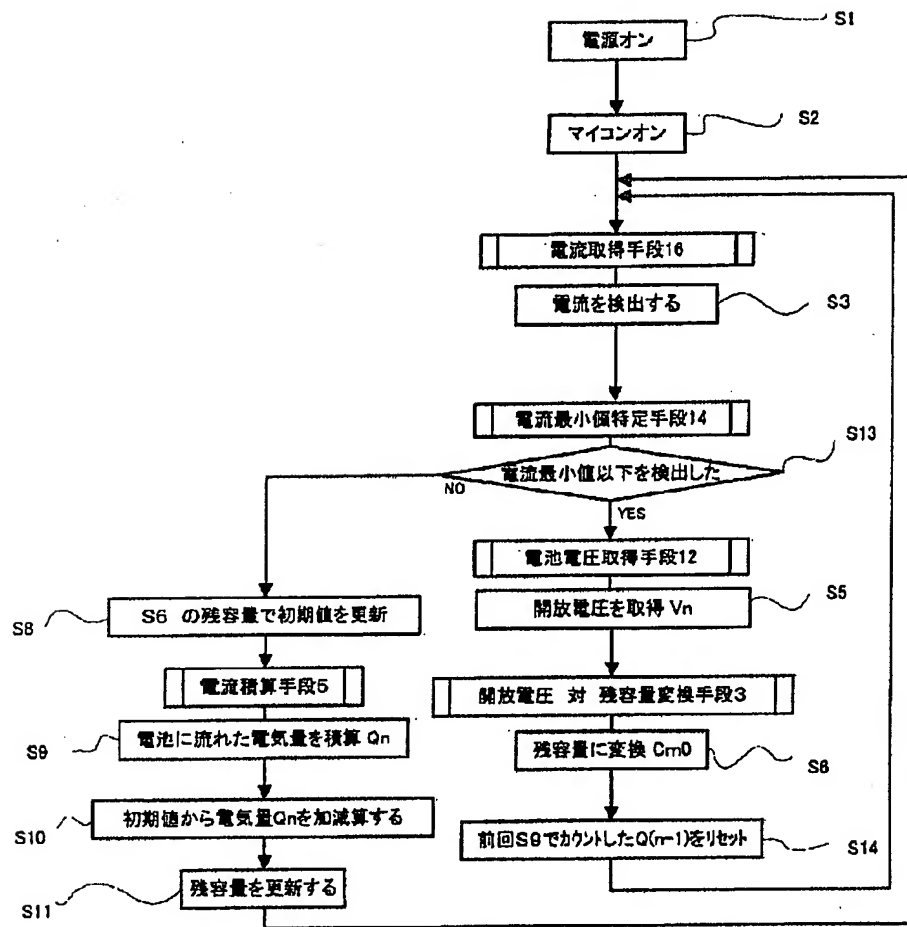
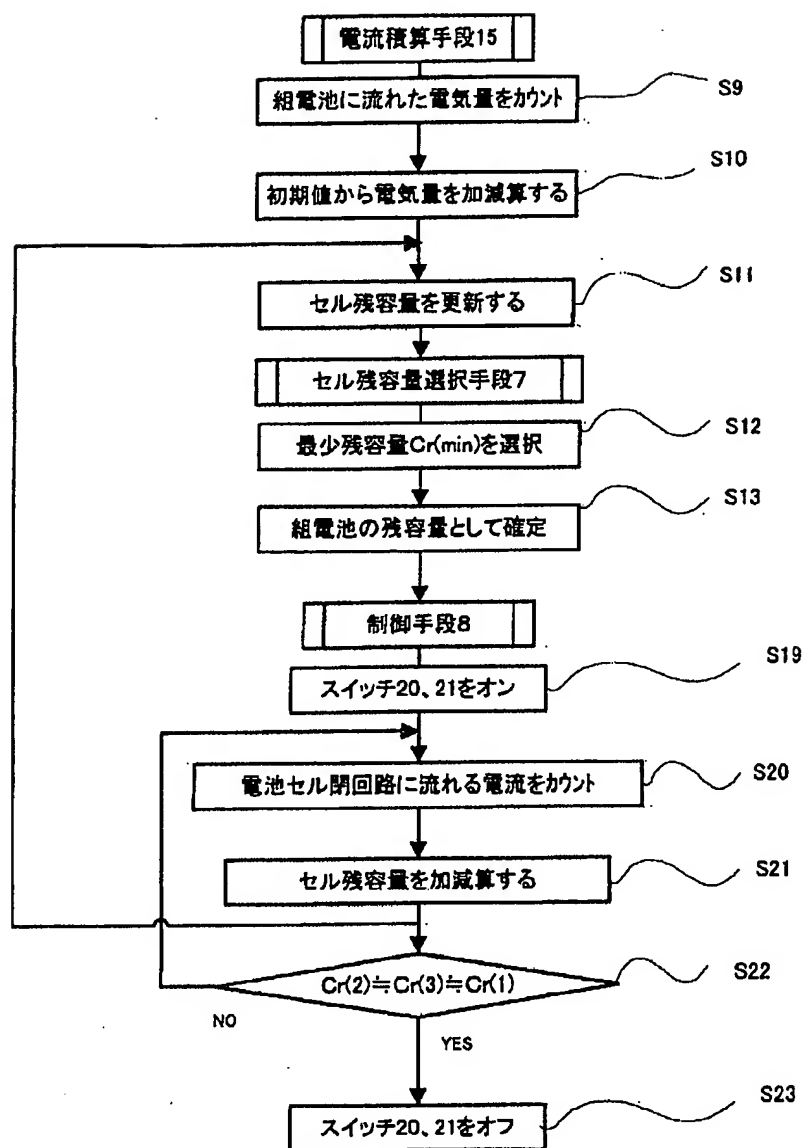
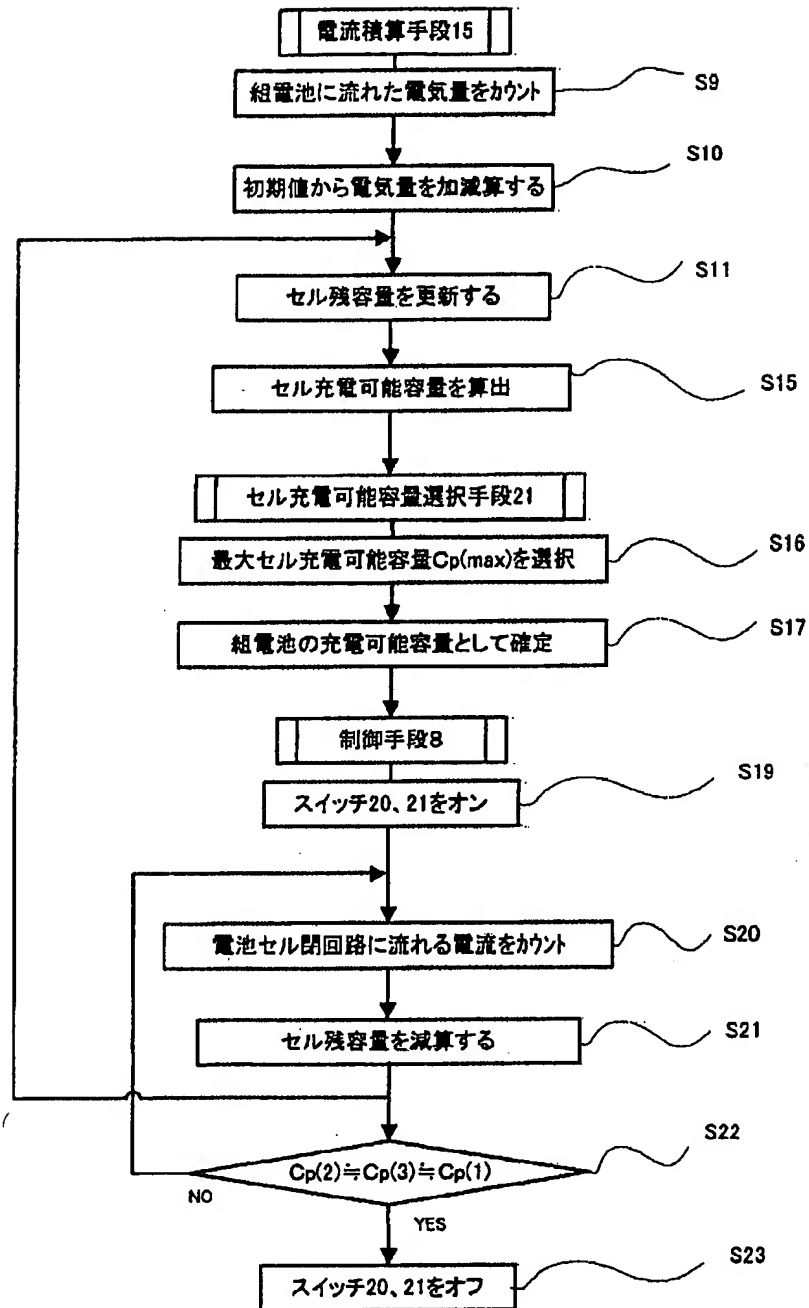


Figure 1 is a block diagram of a battery capacity calculation device. The diagram shows a battery pack 1 with cells 2, 3, and 27. A control unit 19 is connected to the battery pack. A current sensor 22 is connected to the battery pack. A current source 20 is connected to the battery pack. A current measurement unit 21 is connected to the battery pack. A current calculation unit 16 is connected to the battery pack. A current selection unit 14 is connected to the battery pack. A battery voltage acquisition unit 12 is connected to the battery pack. An open voltage to capacity conversion unit 13 is connected to the battery pack. A cell capacity calculation unit 4~6 is connected to the battery pack. A cell capacity selection unit 7 is connected to the battery pack. A cell charging capacity selection unit 21 is connected to the battery pack. A current selection unit 14 is connected to the battery pack. A current measurement unit 21 is connected to the battery pack. A current calculation unit 16 is connected to the battery pack. A current selection unit 14 is connected to the battery pack. A battery voltage acquisition unit 12 is connected to the battery pack. An open voltage to capacity conversion unit 13 is connected to the battery pack. A cell capacity calculation unit 4~6 is connected to the battery pack. A cell capacity selection unit 7 is connected to the battery pack. A cell charging capacity selection unit 21 is connected to the battery pack.

【図7】



【図8】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-077548

(43)Date of publication of application : 14.03.2003

(51)Int.CI.

H01M 10/48

G01R 31/36

H01M 10/44

H02J 7/00

(21)Application number : 2002-162356 (71)Applicant : TAKEI TOSHITAKA

(22)Date of filing : 04.06.2002 (72)Inventor : TAKEI TOSHITAKA

(30)Priority

Priority number : 2001173443 Priority date : 08.06.2001 Priority country : JP

(54) BATTERY MANAGING METHOD AND SYSTEM FOR BATTERY SET

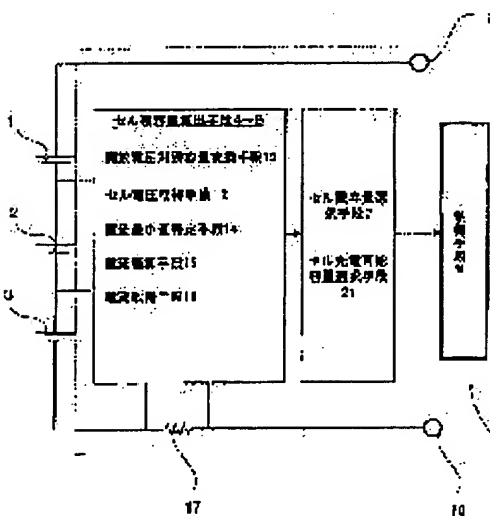
(57)Abstract:

PROBLEM TO BE SOLVED: To accurately find the remaining capacity of a battery set and control the display of the remaining capacity, the safe charge of the battery set and the consumption of power supplied to equipment for solving the problem on the battery set having a plurality of battery cells connected in series when out of cell balance that the remaining capacity of the battery set cannot be actually calculated in spite of the control of the remaining capacity of the battery cells using battery voltage only as usual, thus making it very difficult to manage power supplied to a battery set equipment system in accordance with remaining capacity data for the battery set.

SOLUTION: The display of the remaining capacity of the battery set or the control of the battery set equipment system is performed by controlling the remaining capacity of each battery

cell instead of the voltage of each battery cell. For that purpose, independent and accurate cell remaining capacity calculating means for each cell is provided in battery set managing means.

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CLAIMS

[Claim(s)]

[Claim 1] In the group cell device system constituted from a group cell which consists of two or more cell cells which carried out series connection, and a cell management tool this cell management tool A cell remaining capacity calculation means or a cell charge possible-capacity calculation means, It has a cell remaining capacity selection means or a cell charge possible-capacity selection means, and the control means that carries out control of this group cell device system. This cell remaining capacity calculation means computes the remaining capacity of two or more of these cell cells, and chooses from from this cell remaining capacity used for the remaining capacity of this group cell among these two or more calculated cell remaining capacity. This charge possible-capacity selection means chooses the charge possible capacity of this group cell from from among the cell charge possible capacity computed using this cell charge possible-capacity calculation means. This control means is a group cell management method which controls this group cell device system using this selected cell remaining capacity or this cell charge possible capacity.

[Claim 2] A current addition means for this cell remaining capacity calculation means to count the current which frequents this cell cell, and to calculate quantity of electricity Q, It has a current minimum value specification means, a cell electrical-potential-difference acquisition means to acquire a cell electrical potential difference, and an open-circuit-voltage pair remaining capacity conversion means to change the open circuit voltage of this cell cell into the remaining capacity of this cell cell. When this current minimum value specification means specifies below as the current minimum value, the electrical potential difference of this cell cell is acquired with this cell electrical-potential-difference acquisition means. When this electrical potential difference is changed into the remaining capacity of this cell cell with this open-circuit-voltage pair remaining capacity conversion means and then a current exceeds this current minimum value, while making into initial value this remaining capacity obtained by this open-circuit-voltage pair remaining capacity conversion means The group cell management method of claim 1 which adds or subtracts quantity of electricity Q integrated using this current addition means to this initial value, and updates this remaining capacity of this cell cell.

[Claim 3] This control means is the group cell management method of claim 1 which is a means to display the remaining capacity of this group cell.

[Claim 4] This control means is the group cell management method of claim 1 which is a means to control charge of this group cell.

[Claim 5] This control means is the group cell management method of claim 1 which is a means to change independently the remaining capacity of this cell cell.

[Claim 6] The group cell management method of claim 1 made into quantity of electricity

to which this cell remaining capacity calculation means or this cell charge possible-capacity calculation means integrated the current which flows to the closed circuit for self-voltage adjustment, added or subtracted the current which flows on this whole group cell to quantity of electricity integrated and obtained, and flowed in this cell.

[Claim 7] This control means is the group cell management method of claim 1 which is a means to change the power consumption of this group cell device system.

[Claim 8] The group cell managerial system which uses the group cell management method of claim 1.

[Claim 9] The record medium which programmed the group cell management method of claim 1.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] In the cell device system driven by the group cell, it is related with the cell management method which performs remaining capacity display, charge, power save of a device, balance adjustment of a cell cell, etc., a system, and the record medium which saved the approach.

[0002]

[Description of the Prior Art] Although the gestalt of the cell pack with which the group cell device system stored the group cell and the cell management tool in the case is a base, the gestalt in which a group cell and the body of a set communicate and manage a cell is also included like a notebook computer, a video camera, or a hybrid car. Although a cellular phone, a digital still camera, etc. can be driven with the single cell voltage of one cell also in the device conventionally driven by the cell, even if a lithium ion battery with high cell voltage is used for a video camera, a notebook computer, etc., they are insufficient in single cell voltage. Then, two or more single cells were connected to the serial, it was made the group cell, and desired cell voltage has been obtained. Moreover, in the conventional cell management tool, cell remaining capacity is computed, and it displays on displays, such as liquid crystal, and is used for the management which a user turns off a device or charges. Or if cell remaining capacity decreases, the device which drops the brightness of liquid crystal automatically and is performing cell management which carries out power save also exists. It is the approach all calculate cell remaining capacity and perform cell management based on the information.

[0003] In the case of a single cell cell, calculation of the cell remaining capacity has from the former the current addition approach which integrates the current which frequents the electrical-potential-difference approach changed into cell remaining capacity from the electrical potential difference of a cell cell, and a cell. Or there is an approach which combined the electrical-potential-difference approach and the current approach. In the case of the group cell, it considers that the whole group cell is one cell, the current which frequents the electrical potential difference of the whole group cell and the whole group cell is detected, and the same approach as a single cell cell is enforced.

[0004] Moreover, by the group cell which carried out the series connection, there is a problem on which the electrical-potential-difference balance of each cell cell collapses. As a cause by which the balance of an electrical potential difference collapses, when it

finishes setting up a cell cel on a group cell, the case where the electrical potential differences of a cell cel differ, and the case where the cell capacity of each cell cel differs are raised from the beginning. When the electrical-potential-difference balance of a cell cel collapses, at the time of charge, a cell cel with a high electrical potential difference is overcharged, or there is a problem from which other cell cels become the lack of charge. Moreover, at the time of discharge, while the cell cel with low cell voltage became overdischarge or the cell capacity of other cell cels had remained, there is a problem which becomes discharge final voltage by the whole group cell. Anyway, the usable capacity of a group cell falls as a result. Then, when the electrical potential difference of each cell cel is conventionally detected independently and the difference more than a predetermined electrical potential difference arises on each electrical potential difference, control which discharges and doubles a cell cel with a high electrical potential difference with the electrical potential difference of a cell cel with a low electrical potential difference is performed.

[0005]

[Problem(s) to be Solved by the Invention] Usually, when carrying out series connection of the cell cel and making it a group cell, while using the cell cel of the fundamental almost same capacity, it is taking and finishing setting up the so-called selva lance so that the electrical potential difference of all cell cels may become almost the same. Therefore, when computing the cell remaining capacity of a group cell, even if it is the conventional cell remaining capacity calculation approach between new article cells, it is satisfactory in many cases. However, if charge and discharge are repeated repeatedly, the capacity of each cell cel will become an ununiformity by degradation etc., and the electrical potential difference of each cell cel will also become an ununiformity. Then, in a cell cel with a big cell capacity, even if it is a normal charge electrical potential difference by the whole group cell at the time of charge, there is a problem which becomes a full charge while charge has been insufficient as a group cell without a charge electrical potential difference is insufficient and reaching to a full charge. Moreover, when the discharge final voltage of the whole group cell is reached at the time of discharge, there is a cell cel in which cell capacity still remains, and before using up capacity as a group cell, the problem which becomes a termination electrical potential difference is. Therefore, naturally, there is less real remaining capacity of a group cell than a calculation value, and the precision of a remaining capacity display of the group cell device system which uses the conventional calculation approach falls sharply.

[0006] Since the cell cel with a small cell capacity is moreover overcharged at the time of charge, safety falls, or an overvoltage protection circuit operates by the group cell using a lithium ion cel, the current of a group cell is intercepted, and the big problem it becomes impossible to use a device occurs. Therefore, if the electrical-potential-difference balance of each cell cel collapses conventionally, the closed circuit constituted from a switch and discharge resistance is established in each cell cel, and the management method which carries out selva lance adjustment of discharging until it becomes the electrical potential difference of the cell cel of a low electrical potential difference about the high cell cel of an electrical potential difference is proposed for some kinds. For example, it applies for application-for-utility-model-registration Taira 5-47535, an application for patent 8-200260, Japanese Patent Application No. 9-346550, the application for patent 10-32887, and the Japanese-Patent-Application-No. 11-61307 grade as a patent or a utility model.

However, it is the adjustment approach that any approach makes in agreement the electrical potential difference of each cell cel. however -- even if the same in the electrical potential difference of each cell cel in which cell capacity balance collapsed -- the remaining capacity of each cell cel -- since charge possible capacity until it carries out a full charge does not become the same, gross errors occur for the remaining capacity display precision of a group cell. Since the current which will flow on each cell cel cell which carried out series connection if the charge and discharge of the group cell are furthermore carried out is the same, when the cell cel which is overcharged when it charges occurred and discharges, it has not solved the big problem which the cell cel which becomes overdischarge generates, either.

[0007] Therefore, in the group cell by which the series connection of two or more cell cels was carried out, also when a selva lance collapses, the place made into the purpose of this invention computes the exact remaining capacity of the whole group cell, performs remaining capacity display and control, and aims at offering the management method by which a device user or a device can control a group cell correctly automatically, a system, or the record medium which recorded the approach.

[0008]

[Means for Solving the Problem] In the group cell device system constituted from a group cell which consists of two or more cell cels which carried out series connection, and a group cell management tool, in order to attain the above-mentioned purpose, as for this invention, a group cell management tool has the following technical means. They are a cel remaining-capacity selection means choose the cel remaining-capacity calculation means of two or more cell cels, and the cel remaining capacity used as remaining capacity of a group cell out of two or more calculated cel remaining capacity or the cel charge possible-capacity calculation means of two or more cell cels, a cel charge possible-capacity selection means choose the cel charge possible capacity used as charge possible capacity of a group cell from two or more charge possible capacity, and the control means of a group cell device system. That is, this invention is managing the remaining capacity of each cell cel rather than managing like before only the electrical potential difference of the whole group cell, and management of the current which goes in and out or the electrical potential difference of each cell cel, and is the approach of performing remaining capacity display of a group cell, or control of a group cell device system. Or there is the description which is the system which constitutes the approach, or the record medium which recorded the approach.

[0009] Furthermore, the remaining capacity conversion approach of the cell in which this invention person did patent application by the application for patent 2001-173443 was used for this invention as a means to compute the remaining capacity of a cell cel.

Although remaining capacity calculation of each cell cel in which the selva lance in a group cell collapsed was very difficult conventionally, if the remaining capacity conversion approach of the cell by the application for patent 2001-173443 is used, there is the description which can compute the remaining capacity of a cell cel easily.

[0010] Moreover, using cel ***** which the cel ***** selection means chose from the cel remaining capacity which the cel remaining capacity calculation means computed, the control means of this invention is displaying the remaining capacity of this group cell, and has the description to which the user of a device can carry out power save of a device by initiative.

[0011] Moreover, the control means of this invention has the description which controls charge of a group cell using the cel charge possible capacity which the cel charge possible-capacity selection means chose out of the cel charge possible capacity which the cel charge possible-capacity calculation means computed.

[0012] Moreover, a control means is changing independently the remaining capacity of the cell cel of arbitration, and preparing a selva lance, and this invention has the description which raises safety while pressing down the fall of the usable capacity of a group cell.

[0013] Moreover, this invention is made into quantity of electricity which added or subtracted quantity of electricity which flowed to the closed circuit for selva lance adjustment established independently in each cell cel to quantity of electricity which flowed on the whole group cell, and flowed in each cell cel, and has the description which raises the precision of a cel remaining capacity calculation means or a cel charge possible-capacity calculation means.

[0014] Moreover, the control means of this invention has the description which controls a group cell device system automatically and carries out power save of a device.

[0015] Moreover, this invention has the description to which a control means carries out power save of a device automatically.

[0016]

[Embodiment of the Invention] The gestalt 1 of operation of this invention is explained to a detail using the block diagram of drawing 1. Series connection of the n cell cel is carried out first, and it is made a group cell. In drawing 1, although n is explained as three pieces, if n is two or more pieces, the meaning of explanation will not change. The cel remaining capacity calculation means 4-6 are connected to juxtaposition at each cell cels 1-3, respectively. Moreover, each cel remaining capacity calculation means 4-6 are inputted into the cel remaining capacity selection means 7, respectively. Furthermore, a cel remaining capacity selection means is inputted into a control means 8. And the I/O to a group cell is performed through an anode plate 9 and cathode 10. The program of the cel remaining capacity calculation means 4-6, the cel remaining capacity selection means 7, and a control means 8 of operation is stored in a microcomputer 11.

[0017] this invention person explains the cel remaining capacity calculation means 4-6 by drawing 2 using the remaining capacity conversion approach of a cell which carried out patent application by the application for patent 2001-173443. Although it is a means to compute independently the remaining capacity of each cell cels 1-3, respectively, the configuration is the same, and good, and is a multiplexer etc. about one cel remaining capacity calculation means 4, and, as for the cel remaining capacity calculation means 4-6, may change and use the cell cels 1-3. That is, the remaining capacity calculation means 4-6 consist of the cel electrical-potential-difference acquisition means 12, the open-circuit-voltage pair remaining capacity conversion means 13, a current minimum value specification means 14, a current addition means 15, and a current acquisition means 16. The current acquisition means 16 used the one approach of current detection of detecting the electrical potential difference generated to the both ends of the current detection resistance 17 connected to the cell cels 1-3 at the serial.

[0018] And the flow of operation is shown in drawing 3. Although it is first displayed as step 1 and henceforth (S1), when power-source ON (S1) is carried out, a microcomputer 11 turns on (S2). Next, the current which flows with the current acquisition means 16 is

detected (S3). Next, the current minimum value is specified using the current minimum value specification means 14 (S4).

[0019] Next, the open circuit voltage of the cell cels 1-3 is acquired using the cell voltage acquisition means 12 (S5). Generally, open circuit voltage is an electrical potential difference in case the current which frequents a cell is zero, when the electrical circuit to which the anode plate and negative electrode of a cell are connected is made open. However, since an electrical potential difference will approach open circuit voltage a certain degree if the current is minute, an electrical potential difference when a current becomes below the minimum value may be specified as open circuit voltage. For example, if it is the condition that will await and only the minute current at the time will flow if it is a cellular phone, or a notebook computer, even if it turns off a power source, it has the condition that only the minute current which acquires and carries out memory of the cel electrical potential difference flows. It can be considered that the cel electrical potential difference at that time is open circuit voltage.

[0020] Next, the open circuit voltage (S5) of the acquired cell cels 1-3 is changed into remaining capacity using the open-circuit-voltage pair remaining capacity conversion means 13 (S6). The open-circuit-voltage pair remaining capacity conversion means 13 measures the cell property at the time of being the first stage when the cell cels 1-3 have not deteriorated beforehand, acquires the data of open-circuit-voltage pair remaining capacity, uses them as a translation table 18, and is saved at nonvolatile memories, such as ROM.

[0021] Next, if a current begins to flow exceeding the minimum value (S7), remaining capacity (S6) of the cell cels 1-3 changed and obtained is made into initial value (S8), using the current addition means 5, the flowing current will be integrated and quantity of electricity Q which flowed will be counted (S9). By the way, in this specification, the discharge current is added and the charging current is calculated by minus.

[0022] Next, quantity of electricity Q (S9) counted from the initial value (S8) of the remaining capacity of the cell cels 1-3 is subtracted or added (S10). In this way, the remaining capacity of the cell cels 1-3 is updated to new remaining capacity, subtracting or adding initial value (S8) by quantity of electricity Q (S9) (S11).

[0023] About the flow [so far] (S1) of operation and each cell cels 1-3, - (S11) carries out independently, respectively. Therefore, three remaining capacity is obtained. The remaining capacity of the cell cels 1-3 is displayed as Cr(1) -Cr(3), respectively.

[0024] Next, with the cel remaining capacity selection means 7, cell cel remaining capacity with least remaining capacity is chosen from Cr(1) -Cr(3) (S12), and the remaining capacity of a group cell is decided (S13).

[0025] Next, the settled group cell remaining capacity (S13) is inputted into a control means 8. A control means 8 performs a remaining capacity display to a liquid crystal display etc. A device user checks the remaining capacity of a group cell, and the power source of a device can be cut or he can perform cell management of exchanging cells.

[0026] Next, the gestalt 2 of the operation which controls charge of a group cell is explained. The configuration of the cell cels 1-3 and the group cell management tool 20 is the same as drawing 2 shown with the gestalt 1 of operation. Moreover, since step (S1) - (S11) of the flow of operation shown in drawing 3 is the same, henceforth (S11) is shown in drawing 4. Now, when it finishes setting up on a group cell, it is not necessarily the same from from, the remaining capacity, i.e., the capacity, in a full charge of each cell

cells 1-3. Moreover, the variation in each capacity is expanded by factors, such as degradation. Then, if the capacity of each cell is distinguished, it is displayed as $C_f(1)$ - $C_f(3)$ and charge possible capacity is displayed as $C_p(1)$ - $C_p(3)$, the relation of (1) type will be materialized.

[0027]

[Equation 1]

[0028] And the cell charge possible-capacity selection means 21 calculates $C_p(m)$ by (1) formula, and chooses fewest $C_p(\min)$ in it (S16). Next, the $C_p(\min)$ is decided as it is the charge possible capacity of a group cell (S17). Next, only $C_p(\min)$ charges a group cell using a control means 8 (18). Then, a group cell can be charged to maximum capacity, without overcharging any cell cells 1-3.

[0029] As described above, each capacity C_f of each cell cells 1-3 (m) is not necessarily the same. If the capacity of each cell cell furthermore changes with degradation, since whenever [cell cells' 1-3 constructed by group cell's degradation] is uncomputable, $C_f(m)$ cannot be calculated by the conventional cell remaining capacity calculation approach. It can be said that neither the conventional electrical-potential-difference approach nor the current addition approach can calculate the real remaining capacity and real charge possible capacity of each cell cells 1-3 in the present condition that $C_f(m)$ cannot be found since $C_f(m)$ becomes a reference value or initial value.

[0030] It is there. The gestalt 3 of the operation which is the approach of calculating and amending $C_f(m)$ of each cell cell is explained using the flow Fig. of drawing 5 of operation. Drawing 5 is the calculation approach of whenever [capacity degradation / which was shown in the application for patent 2001-173443]. first -- below the current minimum value -- detecting (S13) -- each open circuit voltage V_n of the cell cells 1-3 is acquired (S5), and it changes into the cell remaining capacity $Crn0$ (S6). Like V_n , the sign n with the bottom shows the count which detected below the current minimum value, and $Crn0$ shows the n -th cell remaining capacity of the cell cell when having not deteriorated here.

[0031] Next, although it returns to step 13, $Crn0$ is carried out to it being the current on which the current which flows on a group cell exceeds the current minimum value at initial value (S8), and quantity of electricity Q_n which flows on a group cell is counted (S9). Counting up quantity of electricity Q_n is continued until it detects the current minimum value again (S13) (S9). again -- below the current minimum value -- detecting (S13) -- open circuit voltage $V(n+1)$ is acquired (S5), and it changes into the cell remaining capacity $Cr(n+1)0$ (S6). By the way, the cell remaining capacity $Crn0$ and remaining capacity $Cr(n+1)0$ are the remaining capacity changed from open circuit voltage V_n and $V(n+1)$ with reference to the open-circuit-voltage pair remaining capacity conversion means 13 18, i.e., the table of drawing 3, (S6). The cell remaining capacity calculated from a table 18 is the remaining capacity of the criteria cell cell in which the cell cell has not deteriorated. It is an electrical potential difference V (it is the capacity actually used in between [until it acquires $n+1$ (S5)].) again from on the other hand quantity of electricity Q_n acquiring an electrical potential difference V_n (S5). Therefore, the basic type of α is expressed with (2) types whenever [cell degradation / which shows the ratio into which the cell cell deteriorated].

[0032]
[Equation 2]

[0033] In degradation [of a formula (1)] whenever α_{phac} , if it is the cell which has not deteriorated, α_{phac} is 1 and is made the treatment which becomes so large that it deteriorates. Moreover, quantity of electricity Q_n at the time of discharge is treated by plus, and quantity of electricity Q_n at the time of charge is treated by minus. However, when Q_n is very small, the difference of V_n and $V_{(n+1)}$ also becomes small, and there is a possibility that it may become impossible to distinguish an electrical-potential-difference difference with the cell electrical-potential-difference acquisition means 12. Then, only in more than the specified quantity, Q_n needs to adopt. What is necessary is to carry out this example, only when Q_n is fully large and α_{phac} can be found correctly whenever [cell degradation], since degradation of a cell cell tends to progress gradually and does not need to update α_{phac} whenever [cell degradation] frequently.

[0034] Although not shown in the flow of drawing 5, when α_{phac} is not 1 whenever [cell degradation / which was able to be found in this way], the cell remaining capacity C_{rn0} of step 6 is broken by α_{phac} , is amended, and the real remaining capacity C_{rn} is calculated. Moreover, the initial value of step 8 also updates the cell remaining capacity C_{n0} to cell real remaining capacity. Amendment is expressed with (3) types. It is shown that m computes independently about each cell cell 1-3.

[0035]
[Equation 3]

[0036] Moreover, C_f is expressed with (4) types, when net volume C_f is made into the cell real remaining capacity at the time of the full charge in consideration of degradation of a cell and cell remaining capacity at the time of the full charge of a criteria cell is made into capacity C_{f0} .

[0037]
[Equation 4]

[0038] Usually, when connecting the cell cells 1-3 and making it a group cell, capacity C_{f0} of the cell cells 1-3 of one **** is not surveyed. However, in order to make it homogeneity as much as possible, the cell cell in the same production lot is combined. Therefore, cell properties, such as a discharge curve and a charge curve, are similar mostly. Therefore, if the average property of the production lot is surveyed and the standard capacitor C_{f0} (avr) is determined beforehand, $C_f(m)$ can replace $C_{f0}(m)$ of (4) types by C_{f0} (avr), and can amend and calculate it by the formula (2) and the formula (4).

[0039] Thus, since the net volume at the time of the full charge of each cell cells 1-3 can be found even if it changes by factors, such as degradation, cell remaining capacity and cell charge possible capacity are computable. Therefore, by the control means 8, the exact remaining capacity and charge possible capacity of a group cell can display on a liquid crystal display etc. Moreover, overcharge of the cell cells 1-3 can be prevented, and safety can be raised.

[0040] Next, a control means 8 explains the gestalt 4 of the operation which takes the selva lance of the cell cels 1-3 using the block diagram of drawing 6 . It is the configuration of having connected switches 19-21 and the balance resistance 22-24 to juxtaposition at the serial, and having added closed circuits 25-27 to each cell cels 1-3 at drawing 2 .

[0041] Next, drawing 7 which changed drawing 3 is explained so that it may become a flow of operation in case a control circuit 8 maintains balance using the real remaining capacity of the cell cels 1-3. Drawing 7 shows henceforth from step 9 of drawing 3 . Cel remaining capacity chose the minimum remaining capacity Cr (min) from the result (S11) of remaining capacity calculation of the cell cel 1-3 first (S12). For example, supposing it is the cell cel 1, there are more remaining capacity Cr of other cell cels 2 and 3 (2) and Cr (3) than Cr (1). Then, a switch 20 and a switch 21 are turned on using a control means 8. Then, in a closed circuit 26, an independent current flows in the cell cel 2 through the balance resistance 23, and Cr (2) is consumed. Also in the cell cel 3, it is same that Cr (3) is consumed in a closed circuit 27. Cr (2) and Cr (3) discharge until they become equal to Cr (1), respectively, they turn off (S22), a switch 20, and a switch 21 in the place which became almost equal, and stop discharge in closed circuits 26 and 27 (S23).

[0042] By the way, while switches 20 and 21 turn on, at step 20, the current which flows to closed circuits 26 and 27 is counted, current addition is also performed, and it subtracts from the cel remaining capacity which updated the quantity of electricity at step 11 (S21). It is returned to step 11 and it updates to cel remaining capacity also including quantity of electricity which flows to a closed circuit. Thus, when it controlled so that the cel remaining capacity Cr (2), Cr (3), and Cr (1) became equal and a group cell reaches discharge final voltage, the electrical potential difference of each cell cels 1-3 also turns into a termination electrical potential difference equally, and the remaining capacity of the cell cels 1-3 can secure a normal selva lance while becoming zero equally.

[0043] Next, drawing 8 which changed drawing 7 so that a control circuit 8 might become a flow of operation in the case of taking a selva lance using the real charge possible capacity of the cell cels 1-3 is explained. The maximum cel charge possible capacity Cp (max) was first chosen from the result (S15) of cel charge possible-capacity calculation of the cell cels 1-3 (S16). For example, supposing it is the cell cel 1, there are less charge possible capacity Cp of other cell cels 2 and 3 (2) and Cp (3) than Cp (1). Then, a switch 20 and a switch 21 are turned on using a control means 8 (S19). Then, in a closed circuit 26, an independent current flows in the cell cel 2 through the balance resistance 23, and Cr (2) is consumed. Also in the cell cel 3, it is same that Cr (3) is consumed in a closed circuit 27. until, as for Cr (2) and Cr (3), Cp (2) and Cp (3) become equal to Cp (1) -- discharging -- almost -- equal -- having become (S22) -- a switch 20 and a switch 21 are turned off in time (S23), and discharge in closed circuits 26 and 27 is stopped.

[0044] Moreover, at step 20, a current is counted, current addition is also performed and it subtracts from the cel remaining capacity which updated the quantity of electricity at step 11 (S21). It is the same as that of the case of discharge to return it to step 11 and to update cel remaining capacity also including quantity of electricity which flowed to the closed circuit. Thus, since the cell cels 1-3 will also become a full charge equally when a group cell reaches a full charge if it controls so that the cel charge possible capacity Cp (2), Cp (3), and Cp (1) become equal, the cell cel which is overcharged is not generated.

Therefore, the normal selva lance in charge is securable.

[0045] Next, a control means 8 explains the gestalt 5 of the operation which controls the power consumption of a group cell device system automatically. For example, if it is a video camera and the remaining capacity of a group cell will run short, power save of switching off the back light of liquid crystal will be performed. Moreover, if it is a cell motor and the hybrid car driven by the gasoline engine and the remaining capacity of a group cell will decrease, control changed from cell motorised to a gasoline engine drive will be performed. Since automation of these device control is a well-known technique, the detailed explanation using a drawing is omitted.

[0046]

[Effect of the Invention] In claim 1, only the electrical potential difference of the whole group cell, management of the current which goes in and out, or the electrical potential difference of each cell cel is not managed like before, but the remaining capacity of each cell cels 1-3 which searched for the remaining capacity calculation means using 4-6 is managed. Therefore, even if it is the group cell by which the selva lance collapsed, remaining capacity display of a group cell or control of a group cell device system is performed by the real remaining capacity of an exact group cell. There is effectiveness which solves the trouble that the management precision of the whole group cell falls and goes as a selva lance collapses as a result.

[0047] It is adopting the remaining capacity conversion approach of the cell in which this invention person's did patent application by the application for patent 2001-173443 in claim 2, and the effectiveness which comes to be able to make exact power-source management of a cell device system by becoming possible to calculate correctly the remaining capacity of the cell cels 1-3 in the group cell by which the selva lance made conventionally impossible collapsed is large.

[0048] In claim 3, a control means 8 computes the cel remaining capacity based on claim 1, and it is performing a remaining capacity display and is effective in the ability of a device user to carry out power-source management correctly.

[0049] In claim 4, cel charge possible capacity is computed using the cel remaining capacity which the control means 8 computed based on claim 1, and a control means 8 controls charge based on the count result. Therefore, since it can charge without the cell cel which is overcharged occurring, the effectiveness over safety is large.

[0050] In claim 5, the cel remaining capacity which the cel remaining capacity calculation means computed based on claim 1 is used, and the amount of collapse of an exact selva lance is computed. And since a control means 8 adjusts the remaining capacity or charge possible capacity of a cel by the amount of collapse, the effectiveness that an accurate selva lance is securable has it. [large]

[0051] Moreover, in claim 6, since it is made quantity of electricity which added or subtracted quantity of electricity which flowed to the closed circuits 25-27 for selva lance adjustment established independently in each cell cels 1-3 to quantity of electricity which flowed on the whole group cell, and flowed in each cell cels 1-3, there is effectiveness which raises the precision of a cel remaining capacity calculation means or a cel charge possible-capacity calculation means.

[0052] Moreover, in claim 7, it is effective in the ability to extend the time of a device, since a control means 8 changes the power consumption of a group cell device system automatically.

[0053] moreover, in claim 8, since the exact group cell management method based on claim 1 is constituted to a cell device system, it is effective in the precision of power-source management of a device being markedly easy coming to be alike.

[0054] Moreover, in claim 9, it is saving at record media, such as ROM in a microcomputer, the program of the exact group cell management method based on claim 1 is mass-produced, the cost can be cut down, and there is effectiveness which can miniaturize a group cell device system.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram of the group cell management method of the gestalt 1 of operation.

[Drawing 2] It is the block diagram of the group cell management method of the gestalt 1 of operation.

[Drawing 3] It is the flow chart of the group cell management method of the gestalt 1 of operation.

[Drawing 4] It is the flow chart of the group cell management method of the gestalt 2 of operation.

[Drawing 5] It is the flow chart of the group cell management method of the gestalt 3 of operation.

[Drawing 6] It is the block diagram of the group cell management method of the gestalt 4 of operation.

[Drawing 7] It is the flow chart of the group cell management method of the gestalt 4 of operation.

[Drawing 8] It is the flow chart of the group cell management method of the gestalt 4 of operation.

[Description of Notations]

1, 2, and 3 are a cell cel.

4, 5, and 6 are a cel remaining capacity calculation means.

7 is a cel remaining capacity selection means.

8 is a control means.

9 is an anode plate.

10 is *****.

11 is a microcomputer.

12 is a cel electrical-potential-difference acquisition means.

13 is an open-circuit-voltage pair remaining capacity conversion means.

14 is a current minimum value acquisition means.

15 is a current addition means.

16 is a current acquisition means.

17 current-detection-resists.

18 is a translation table.

19, 20, and 21 switch.

22, 23, and 24 balance-resist.

25, 26, and 27 are a closed circuit.

DRAWINGS

[Drawing 1]

[Drawing 2]

[Drawing 3]

[Drawing 4]

[Drawing 5]

[Drawing 6]

[Drawing 7]

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[Drawing 8]

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